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Editor: Vern Riportella, WA2LQQ
Contr. Editor: George Johnson, W0MD
Harold Winard, KB2M
Managing Editor: Bob Myers, W1XT

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AMSAT's Newsletter for the Amateur Space Program. (See last page for details)

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AO-10 Spring Schedule Unveiled

AMSAT has announced a new operating schedule for AO-10 which will go into effect at 0000 UTC on 1 Apr. 85. The new schedule responds to the changes in sun angle now being experienced. It also includes provisions for thermal considerations which will become increasingly important as the season wears on.

The new schedule is shown in the figure in this issue. The mean anomaly points for switchover are:

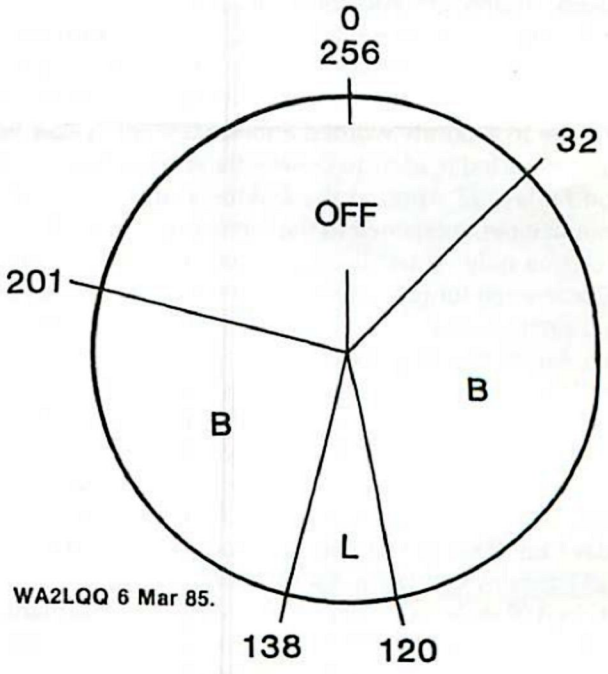
032 - 119 Mode B
120 - 137 Mode L
138 - 200 Mode B
201 - 031 Off

In order to begin maneuvering immediately, the operating schedule was modified slightly on 5 Mar. 85. That modification changed the Mode B startup time from 15 to 32. According to AO-10 command station VE1SAT, the change was required to provide the electrical energy for the torquing magnets. Magnetorquing is a technique for spacecraft attitude adjustment which uses pulsed electromagnets in the "arms" of the spacecraft. The field created by the electromagnets interacts with the geomagnetic field to produce a torque. Pulsing the magnets in a precisely timed sequence can change the orientation of the spacecraft. In effect, the satellite and the geomagnetic field form a motor wherein the spacecraft is the rotor and the geomagnetic field is the stator. Because the strength of the geomagnetic field varies with (among other factors) distance from the earth, it is most effective to pulse the magnetorquers at or around perigee. Thus the need to keep the transponders off slightly longer (from 15 through 31).

According to VE1SAT it would take about two days beginning 5 Mar. to change the orientation of AO-10 to its holding pattern for the month of March, 150 degrees longitude in the orbital plane. It had been at 131 degrees. By 6 Mar., KAØOOQ had noticed improvements in Mode B performance around apogee. This was interpreted as corroboration that the maneuver was working and was having the desired effect.

VE1SAT told *ASR* the operating schedule had been developed in consultation with DJ4ZC and W3GEY and represented a compromise between optimum operating time and schedule stability. Other key milestones pointed to by VE1SAT were as follows. By 1 Apr., the attitude of the spacecraft shall be 170 degrees and excellent operating conditions should have largely returned. The difficulty of working stations to your east will have largely mitigated by this time says VE1SAT. This was due to AO-10 antenna pointing. (See related story and figures herein.) By 1 May the longitude of the spin (Z) axis will be 180 degrees. At this point the spacecraft will be pointing directly towards the geo-center at apogee. This point, called apogee nadir pointing, should provide a perfect balance between east-west QSO ease. However, as spring ebbs into summer, the spacecraft will head towards its most difficult era yet. This will be a time of very serious eclipses and perfectly miserable sun-angles. The spacecraft is expected to emerge from the late summer travail unscathed, but it will take some skillful stewardship on the part of VE1SAT and the rest of the command team to set the appropriate geometry, thermal

AO-10 Transponder Schedule
(Effective April 1, 1985)



Numbers refer to Mean Anomaly. Perigee equals 000. Apogee equals 128. To convert to minutes of time multiply by 2.732.

and energy balance. According to VE1SAT, if we are imprudent here, we may wind up freezing the batteries. To absorb more solar radiation (especially infrared for heating), the spacecraft will be maneuvered in increments past the 180 degree optimum attained in June. By 1 July it will be set at 190 degrees but the operating schedule will remain unchanged. Between 1 July and 1 Aug., the spacecraft will be reoriented from 190 degrees to 230 degrees. The major series of eclipses commences on 4 Aug. and lasts until approximately 1 Sep. The eclipses will occur on each orbit from MA 75 to about 128. A transponder operating schedule change is likely to be required during this period to reduce risk. During this period QSOs to the east will be easier than those to the west. The satellite will be oriented so as to favor stations looking towards the satellite from west of it. This is opposite of the situation which existed late in 1984 and early in 1985 when AO-10 favored stations to its east.

In sum, the next three months may provide some of the best operating on AO-10 this year. By late summer the poor sun angle will be the dominant consideration and determine much of the operating characteristics of the satellite.

Short Bursts

- AMSAT welcomes a bumper crop of new Area Coordinators. In no particular order they are: N8DOD, AAC for NE OHIO; KA5DNP, AAC for the Houston area; N5EAL, AAC for the Houston area; KØQQ AC for ND; KB4DVN, AC for SC; KG6LC, AAC for NH; K1LJL, AC for VT; N1BRQ, AC for VT also; WD5IKD, AC for MS; NC5Y, AAC for MS; AMSAT congratulates the new appointees and welcomes a hearty welcome to the "A Team"!
- G4CEO and G4ZHG will set off for the Isle of Mann (GD) for an AO-10 DX-pedition 12 thru 18 Apr. Watch for them.
- W8DX has worked HL1EJ on AO-10.
- Moreover, W8DX has worked W3GEY on AO-10.
- And if you don't know why that's significant, you haven't been around OSCARs long enough! Hi!
- Heath has its own packet TNC coming out soon. It's a licensed version of the famous TAPR TNC. Called the HD-4040, it will be compatible with other AX.25 machines.
- Due to a poorly worded announcement in *ASR* 96, we may have led readers to believe there would be no forums on Friday, 27 April, at the Dayton Hamvention. The announcement pertained to the International VHF/UHF Conference only. Thus, although there will be no VHF/UHF Conference forums on Friday, there WILL be a complete program of other forums to attend and enjoy. Sorry for the confusion this may have caused.
- The Dayton Amateur Radio Association has presented AMSAT with a $1000 cash grant donation. K9PVW accepted the check from DARA in Dayton on 1 March.
- AMSAT's forums at the Hamvention this year will cover three days. On Friday they will be from 1300 to 1500; Saturday from 0900 to 1100; Sunday from 1115 to 1300. All AMSAT forums will be in Room 3 this year.
- In *ASR* 96 in our story on the Mode L performance improvements, we mentioned the failure of a bias regulator transistor which has caused the HELAPS to operate in a nonlinear regime. W3GEY correctly points out that the regulator transistor is part of a power conditioning unit and not part of the HELAPS per se. He goes on to note that problem is thus external to the HELAPS and AMSAT believes the HELAPS itself is functioning as designed.
- MARCE is due to fly again on 30 May 85 aboard Shuttle 51G according to W4QAU. Downlinks will be on orbits 23, 39 and 55. Watch for ground tracks in *ASR* soon.
- The second printing of the Satellite Experimenter's Handbook is back in stock at AMSAT HQ.
- The Charlotte, NC Convention is the weekend of 16-17 March. AMSAT booth will be organized by WB2LEI/4 and W4TZU. WA2LQQ will attend and speak to an AMSAT Forum on Saturday, 16 March. Contact WB2LEI or W4TZU if you'd like to help out.
- The ACSSB kits offerred by ARRL as part of Project Companion have been completely sold out according to ARRL.

Operating Event Set To Note Milestone

On 31 Mar. 85, AO-10 will reach an important orbital milestone. On that date the latitude of apogee will move to the Southern Hemisphere for the first time passing over the equator on the last day of March.

To note this significant occasion, AMSAT is sponsoring a weekend operating event on OSCAR 10. The basic objective is to work as many stations as possible in the opposite hemisphere. Here are the rules.

AMSAT First-Ever Trans-Equatorial DX Event

1. One point is awarded for each valid CW or SSB QSO on AO-10 with station in the opposite hemisphere. Northern Hemisphere works Southern Hemisphere and vice versa.

2. Event begins 0000 UTC 30 Mar. 85 and end 2359 UTC 31 Mar. 85.

3. No repeat contacts within a mode. You may work the same station on Mode B and Mode L and garner 1 point for each contact, however.

4. Exchanges shall be callsign, signal report and latitude in degrees north or south. Logs shall record this exchange.

5. Logs must arrive at AMSAT not later than 30 Apr. 85. Mail to AMSAT, P.O. Box 27, Washington D.C. 20044.

6. One prize (an article of radio equipment) will be awarded to the top finisher in each hemisphere. The value of the prizes shall each approximate at least $50 U.S.

7. Excessive dupes cause disqualification as do phony QSOs. Cheaters will be flogged naked at the masthead and otherwise humiliated!

8. Prizes will be awarded by 1 July 85. Notice of the winners will be published here and in the usual places.

First Details Of Phase 3C Satellite Revealed

With a mid-1986 launch date in hand, AMSAT teams around the globe are tooling up for an ambitious follow-on project to Phase 3B (now AMSAT OSCAR 10). The new project will lead to the construction and launch of Phase 3C. Announcement of preliminary details was made recent-

ly as proposals circulated among designers in the "Satellitten Gesellschaft" of AMSAT DL and AMSAT teams in Washington and Boulder. If all the proposed communication subsystems options are implemented, Phase 3C could carry as many as 4 transponders ranging in frequency from 2 meters to 13 cm. New modes and techniques could make this project one of the most exciting ever.

Here are the preliminary details as announced recently by AMSAT's Jan King, W3GEY, Vice President for Engineering, the hub of the newly organized Boulder, Colorado team.

The first transponder to be carried aboard Phase 3C will be a Mode B transponder quite similar to AO-10's. With uplink on 70 cm and downlink on 2 meters, it will have about 180 kHz of bandwidth. The frequencies used will be dissimilar to AO-10's to avoid mutual interference. The transponder used could be the actual flight spare which was back-up for the flight unit flown on Phase 3B (AO-10). This transponder has been in storage since AO-10 launch day.

The second transponder, if built as planned, could break some new and interesting ground. Tentatively dubbed Mode JL, the transponder would combine uplinks from 2 meters and 24 cm into a downlink on 70 cm. Approximately 50 kHz of the 2 meter band would either overlap or be placed adjacent to the downlink resulting from the 24 cm uplink. Mode J gained popularity especially in Japan where 2 meter QRM is intense. Mode B, with its 2 meter downlink is not popular in Japan for this reason. It's just too difficult to hear well on the Mode B system with all the QRM. Thus the Mode J synthesis with the Mode L transponder could open new vistas for Japanese hams as well. Regarding the Mode L portion of the proposed Mode JL transponder, this would have up to 800 kHz of bandwidth and an improved efficiency HELAPS amplifier according to W3GEY.

The third transponder is one specifically opted by a new group in West Germany. It will be a Mode L packet transponder. Details are sketchy for the present but it appears the following represent initial directions. The packet transponder will use Mode L, require 2400 bps FSK on the uplink and generate 400 bps FSK on the downlink.

The fourth transponder proposal has just recently been codified in a written document so details here too are fragmentary. This much is known, however. The mode (at present unnamed) will use 70 cm for an uplink and generate a 13 cm downlink in the vicinity of 2.4 Ghz. This transponder will be suitable for a single FM signal approximately 20 kHz wide. The downlink will be at approximately the 2 watt level.

To save time and added expense, it has been decided to proceed with spacecraft construction using the backup Phase 3B spaceframe. W4PUJ will modify the frame for use with Phase 3C and the added subsystems.

The kick motor to be employed will be identical to that used on Phase 3 B. Revisions to the plumbing associated with the MBB 400 Newton motor, however, will be designed to reduce the risk that unexpected low temperatures as experienced with the Phase 3B launch could preclude kick motor refiring. Loss of helium probably due to very cold temperatures is thought to have contributed to the inability to reignite the perigee kick motor on AO-10. This resulted in an orbital inclination of 26 degrees instead of the design objective of approximately 60 degrees inclination. The redesigned valves and plumbing should reduce the risk of a similar misfortune on Phase 3C.

Phase 3C will use the bi-propellant system employed by Phase 3B with one improvement. Whereas Phase 3B used the hypergycol combination of UDMH and N202, Phase 3C used a fuel yielding an improved specific impulse; more "kick" from the kick motor. The fuel, UDMH is unsymmetrical di-methyl hydrazine. N202 is nitrogen tetroxide, the oxidizer. When these two components are combined they explode spontaneously without need for an igniter or catalyst. The bi-propellant system to be used on Phase 3C will be similar to the Phase 3B fuel and oxidizer but will improve the specific impulse by 10%. This should compensate somewhat for the anticipated increased total mass of Phase 3C compared to Phase 3B. The Ariane launcher will place Phase 3C in a geo-synchronous transfer ellipse with zero degrees inclination. It is then up to AMSAT to accomplish two key maneuvers in a precise series of steps. The first is to raise the perigee from its perilously low point of a few hundred kilometers to a stable orbit. The second major maneuver will be to accomplish a sizeable plane change from zero to approximately 60 degrees. The initial argument of perigee also must be determined and set precisely in these initial maneuvers. The more mass is represented by the spacecraft, the more "kick" is required to accomplish a given maneuver. Thus the key to achieving the desired orbit with a more massive spacecraft is more "kick" realized through a more potent fuel/oxidizer pair.

According to the report by W3GEY, AMSAT and AMSAT DL will likely want to "revisit the overall antenna design on Phase 3C." It is generally conceded that the 2 meter high gain array on AO-10 could be better even taking into account the apparent damage sustained during deployment. "The basic problem," says W3GEY, "is the spacecraft is small compared to 2 meters. Consequently, the 2 meter array is not terribly good. On the other hand, the 70 cm array performs quite well as does the 24 cm helix. We'll want to take a look at the entire antenna suite and see what we can improve upon. We also need to see what we will do for a 13 cm antenna. That will probably be a small helix."

The other key subsystems will be identical to that flown of AO-10 or quite similar. Many sub-systems such as the IHU, BCR and SEU are already built (as flight spares for Phase 3B) and need only be verified and integrated. (IHU is the Integrated Housekeeping Unit, a computer; BCR is the Battery Charge Regulator; SEU is the Sensor Electronics Unit). According to W4PUJ, a new LIU (Liquid Ignition Unit) will be required to work with the new plumbing to be designed for Phase 3C.

A key decision made recently was to not employ an experimental plasma kick motor aboard Phase 3C. The plasma kick motor experiment was apparently judged too risky (schedule and technical risks). Had it been employed, the plasma kick motor would have had at least two major consequences. First, because of the very low thrust of the plasma kick motor system, the movement of Phase 3C from the transfer ellipse to the final orbit could have taken several months; a long, long time for a world of amateurs waiting for a new satellite to come "on-line"! Second, if the plas-

ma kick motor had been opted, it likely would have required an increased battery capacity. With these larger batteries aboard it might have been possible to power (for short periods) a very high power Mode L transponder for specific demonstrations. The available power of the spacecraft depends on the solar panel capacity. AO-10 is in the 50 watt class at start of life with a gradual reduction in efficiency due to solar radiation. The larger batteries aboard Phase 3C would have been needed for the plasma engine and later could have been used for a very high power transponder. The larger batteries would have required a redesign of the spaceframe and added risk there too. Thus the decision to employ the MBB kick motor stabilizes the overall Phase 3C Program by eliminating the risks associated with new technology employment.

With launch less than 18 months away, the construction teams are getting up to full speed to meet their dates with history. Phase 3C...soon to take its place as the most capable OSCAR ever built!

RS-10 Specs Told; Ground Tests Proceed

Reliable sources have told *ASR* that two RS satellites will be launched from the Soviet Union this year. In *ASR* 97, we read of the tests being performed on RS9. Now comes word of similar tests on RS-10.

According to G3IOR who quotes UA3CR, both RS-9 and RS-10 are in Kaluga 200 km SW of Moscow undergoing testing. The frequencies for RS-10 were provided by G3IOR as follows:

Mode A	145.96 - 146.00 up
	29.46 - 29.50 down
Beacon	29.457 or 29.503 either 250 mW or 1 watt
Mode K	21.26 - 21.30 up
	29.46 - 29.50 down
Robot	21.140 up
	29.457 or 29.503 down

A third (unnamed mode) transponder may also be included. Its frequencies were specified as follows:

	21.26 - 21.30 up
	145.96 - 146.00 down
Beacon	145.957

At present, both RS-9 and RS-10 are to be orbited by a single launcher. However, the builders and organizers are thought to be seeking separate launches for each. The desired orbits would be around 2000 km polar circular orbits according to G3IOR.

In related news, UA3CR has built a Mode J transponder for which he is seeking a launch.

The current operating schedule for the operational RS's is, according to G3IOR, as follows:

RS-5 Monday and Friday
RS-7 Tuesday and Saturday (Xpondr or robot)
RS-8 Thursday and Sunday

Spacecraft Orientation and Sun Angle

Mini-Tutorial #1

Spend a minute here and learn some more about satellites and their operation.

In order to understand why proper spacecraft orientation is essential and the effect it has on spacecraft performance, it is necessary to have only a visual picture of the geometry involved.

Refer to Figure 1. The Z axis is the satellite's spin axis. AO-10 revolves about this axis at about 36 rpm. In order for the solar panels to make maximum use of available sunlight, the sunlight must be normal to (perpendicular to) the Z axis. In Figure 1, the sun, S, lies in the lower of two intersecting planes. The spacecraft's Z axis is normal to the plane

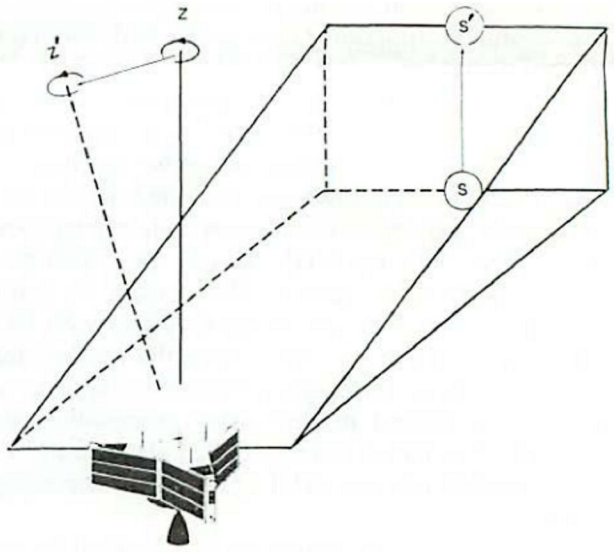


Fig. 1 — Spin axis relation with the sun.

and maximum energy is recovered and passed to the power storage and conditioning systems.

Note also that the Z axis is also the center of all antenna beam patterns. This is called "boresight" meaning dead-center in all beam patterns. The 2 meter omni antenna (the axis of the helix seen in Figure 1) points in the direction of maximum radiation of the antennas (except for the omni itself which is designed to have a torus-like pattern wherein the "hole" in the torus is the Z axis).

With changing seasons, the relation of the sun to the spacecraft's orbit changes. Here we show that as a plane change where the sun moves from S to S'. With the sun in the new plane, the Z axis of the spacecraft must be changed from Z to Z' to assure sunlight continues to approach the satellite perpendicular to the Z axis.

Figure 2 shows another point essential to understanding the geometry involved. Here we see the three primary communication antenna arrays and their relative beam widths and directions. In order of increasing beamwidths are the 24 cm array, the 70 cm array and the 2 meter high gain array. Thus it is possible under varying circumstances to be within one beam and without another. For instance, when working Mode B, it is possible to be hearing well by rea-

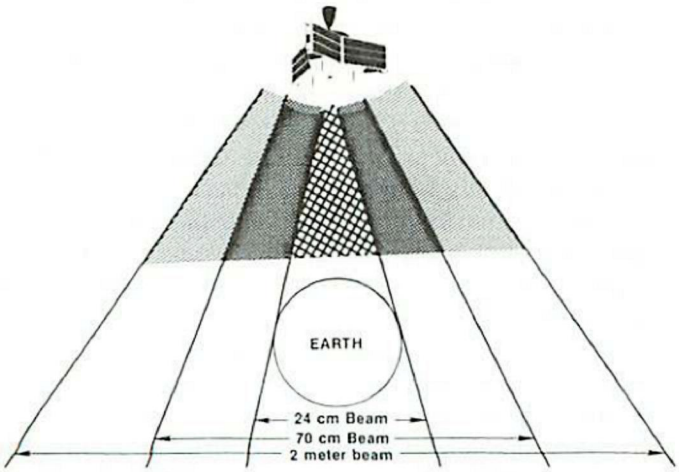
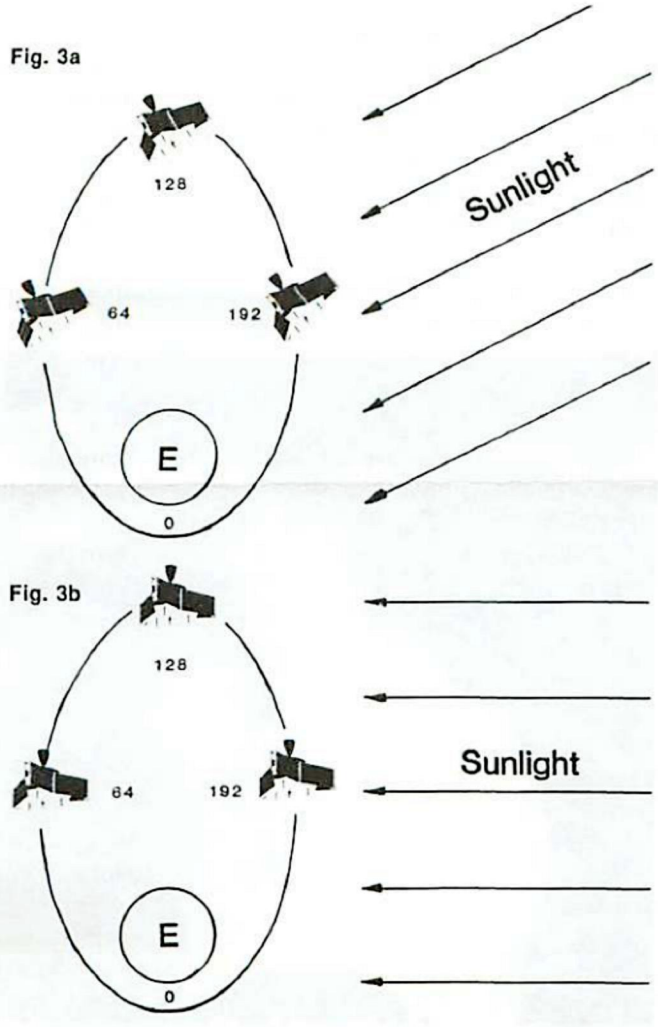


Fig. 2 — Relative earth diameter when the satellite is at apogee.

son of being within the 2 meter beam but not getting into Mode B well because of being outside of the 70 cm beam. An analgous situation can obviously exist with Mode L. That is, one can be hearing the Mode L downlink well at 70 cm but not getting into Mode L well because of being outside of the 24 cm helix beam. Also it should be noted that the pointing precision required for Mode L operation is substantially "tighter" than Mode B.



Effect of changing sun angle.

From Figures 1 and 2 we can infer that changing the spacecraft orientation to respond to seasonal sun-angle changes can have dramatic effects on satellite performance.

This is clearly evident from Figure 3.

Figure 3a symbolizes the situation AO-10 has experienced for the last several months. Because of the sun angle and the need to have the Z axis near perpendicular to the incoming sunlight, it was necessary to off-point the satellite at apogee (MA 128). However, at MA 64, we can see in Figure 3a, the antennas were boresighted on the geo-center. On the other hand, at MA 192, we can see the cause of the severe degradation experienced in recent months. The satellite is off-pointed by a substantial degree. Moreover, stations to the east of the satellite had an easier time of it for reasons that may now be more apparent. (Off-axis by a lesser degree than those west of the satelite.)

In Figure 3b, the seasonal changes in the relation between AO-10's orbit and the sun have allowed an improved orientation. Note that the satellite can now be nadir-pointing at apogee yet have sunlight incident perpendicular to the Z axis. Moreover, at MA 64 and 192 (¼ and ¾ thru the orbit, respectively), the relative off-pointing is equal. Finally, working east or west through AO-10 is equally facile at this orientation.

We can now see how the fundamental driver, sun angle, affects the orientation requirements of AO-10 and the effects such geometric relations have on satellite performance as observed from the ground.

Satellite Construction Hits High Gear

Several active projects could see as many as five major OSCAR launches in the next 18 to 24 months. Additionally, several GAS-Can escape acts and more Ham-In-Space reprieves promise a bonanza in amateur space activity in the third quarter of this decade.

With the year not three full months complete, major announcements of new satellite construction projects have surfaced! From the traditional centers of OSCAR construction, Marburg, Washington and Moscow comes news of dramatic new space-borne capacity to be launched in the next two years. Further, from new centers of excellence, Boulder and Tokyo, teams have vibrant projects under way.

From Washington and Marburg, the home of AMSAT OSCAR 10 comes news that the teams will reprieve the Phase 3B act with an updated version, Phase 3C. Launch is now scheduled for mid-1986 from Kourou, French Guiana aboard the European Space Agency's Ariane 4. Also aboard will be the French Amateur Radio Satellite called Arsene. For the Phase 3C project, however, a new team is emerging virtually from the slopes of the Rocky Mountains in Boulder, Colorado. This new team will join groups in Marburg and Washington in the design, construction, integration and test of the new spacecraft. (See related story on Phase 3C systems elsewhere in this issue).

From Moscow earlier this year came news of plans for the construction and launch of RS-9 later this year. As reported in these pages recently, RS-9 is completed and undergoing ground tests in the Moscow area presently. A late 1985 launch is expected for this newest Radio Sputnik from

the team of UA3CR. Now comes news of plans for RS-10. This spacecraft is also planned for launch later this year. (See related story on RS-10 systems elsewhere in this issue.)

The Marshall Amateur Radio Club Experiment (MARCE) which has already been in space via the Shuttle will fly again as soon as this May according to MARCE Project Leader W4QAU, Ed Stluka. The reflight was offered to MARCE and will occur on flight 51G slated for May 1986. The MARCE package is in a Getaway Special (GAS can) but nothing will be deployed from the can. Instead, several active experiments will be performed and telemetry will be sent via the Amateur bands from a battery-powered transmitter during specific windows of the flight. *ASR* will detail the plans for MARCE including transmit frequencies and orbital information/tracking guides in an upcoming issue.

Meanwhile, progress is being made in Japan where teams from the Japanese Amateur Radio League and specifically from JAMSAT are hard at work on their first indigenous satellite, JAS-1 (Japanese Amateur Satellite -1). No stranger to satellite construction techniques (JAMSAT built the popular Mode J transponder for AMSAT OSCAR 8), this is the first occasion on which our Japanese colleagues will undertake the complete project from inception through to launch and operation entirely on their own. JAS-1, employing a Mode J linear transponder and a Mode J packet transponder as well, will be placed in a novel low earth orbit. The combination of inclination and height will lead to some unfamiliar visibility profiles. Launch is scheduled for early 1986, nominally February.

Topping the interest list of those digitally inclined is PACSAT. PACSAT will be a digital store-and-forward communications satellite. Placed in a low polar orbit from the Shuttle, the PACSAT has been affectionately dubbed the "Flying Mailbox." PACSAT will accept messages from originators on the earth and store them until the addressee interrogates the satellite for his mail. The choice of orbit allows several passes per day for every point on earth. A recent demonstration of the PACSAT-like store-and-forward function was accomplished by the Digital Communications Experiment aboard UoSAT OSCAR 11. (See *ASR* 94/95.) PACSAT is tentatively planned for a 1987 Shuttle launch. However, several significant hurdles must be overcome. One important challenge is authority to deploy from the GAS can. There is at least one GAS can deployment planned this year for a small, experimental payload. This satellite may act as a pathfinder and clear many obstacles to PACSAT deployment from the Shuttle in 1987. PACSAT is a joint project of AMSAT and VITA, the Volunteers In Technical Assistance.

With two successful satellites already in orbit, one might expect the University of Surrey to have plans for a third. Not to be outdone, Surrey's English colleagues within AMSAT UK have floated several trial balloons recently to test sentiment for another British OSCAR.

In the Ham-In-Space department, AMSAT and ARRL anticipate continued success in efforts to place ham radio equipment alongside licensed Amateur-Astronauts and Mission Specialists aboard the US Space Shuttle. Plans for the flight of Dr. Tony England, WØORE, with an impressive array of ham equipment aboard is coming along well. Except for some last minute glitches, we seem to be in good shape according to reliable sources in NASA and AMSAT. In a related development, history's first Ham-In-Space, Owen Garriott, W5LFL, tells *ASR* that because his reflight with Spacelab has been postponed from 1985 to 1986, he has temporarily transferred out of the Astronaut office to the Space Station Project Office. There Owen is Project Engineer for NASA's Space Station Project. Could a permanent ham station be engineered into the station? Seems farfetched? How many a decade ago would have foreseen a ham-astronaut riding a space plane with an Amateur Radio 2 meter HT in his hand?

Judging from the foregoing, even with this superficial treatment, the future bodes well for those in Amateur Space endeavors. And we have listed here only those projects which have firm, identifiable projects with fixed schedules. We have not mentioned the Solar Sail Project of The World Space Foundation, the Amateur Space Telescope of the Independent Space Research Group. Surely there are others which will emerge. In sum, if the harbingers are correct, the next few years will see an unprecedented level of activity in Amateur Space and low-cost satellites.

Operating Aids To Provide User Insight to AO-10 Condx

Responding to a need for a simple means of understanding and predicting AO-10 operating conditions (especially attitude and orientation as it affects performance) AMSAT will shortly introduce two measures designed to aid the user.

A computer program under development will compute the satellite antennas off-pointing angle. In essence, given a simple two-number input, the program will compute the off-pointing angle for a given QTH at that instant. This, in turn, will afford the user a better grasp of what to expect in terms of satellite performance. For example, it has often been perplexing for users who on one occasion are strong through the transponder and on other occasions are weak

Rick Fleeter of TRW explains details of an ion propulsion system which future OSCAR's might use.

despite similar passband loading and range. This program will show the user the apex angle of the cone which intersects the beam from the satellite to the user. If the angle exceeds some given value, the user will know not to expect too much in the way of returns. It will also help to explain why "Joe is so much louder than me when he claims to be running the same power!" The program is being developed by a team of outstanding AMSAT mathematicians and programmers including W3IWI, KA9Q and N4HY. It should be ready for distribution in various (computer) languages and dialects by about 1 May.

How strong a given station is heard depends on a multitude of factors. If all stations were using identical uplink power (ERP) and had identical receive stations, then the factors determining strength of received signal would narrow to three:

1. Passband loading
2. Range to satellite
3. Angle from bore-sight

(We'll ignore some other subtler causes and effects for this discussion.)

The second measure to be put into effect soon involves the use of a simple, three tier benchmark for operating conditions. Based on a loose set of criteria, AO-10 conditions will be described as either "Green", "Amber" or "Red." Using this system, AO-10 has been in an amber condition for the last several months as a consequence of poor sun angle and the necessary orientation of the satellite to respond to the angle. Similarly, as described in another story in the issue, AO-10 will be in condition green for the next three months, approximately. There may be a few weeks of condition red next August.

While at present the criterion for a given condition determination is qualitative and subjective, as the computer program above is developed and an analysis of the AO-10 antenna patterns is performed, a more quantitative and objective set of criteria may be devised. For now, however, the three tier system shall provide merely a general guide as to what may be expected now and for the future as regards AO-10 operation performance.

ORBIT PREDICTIONS BY KA9Q

OSCAR-11
Mon Mar 11 01:09:40.67 1985 UTC:
Ascending node at -49.1
Nodal period: 98.55761 min
Longitude increment: 24.638826 deg w/orbit
Element set 57, epoch:
Wed Feb 20 05:26:20.242 1985 UTC

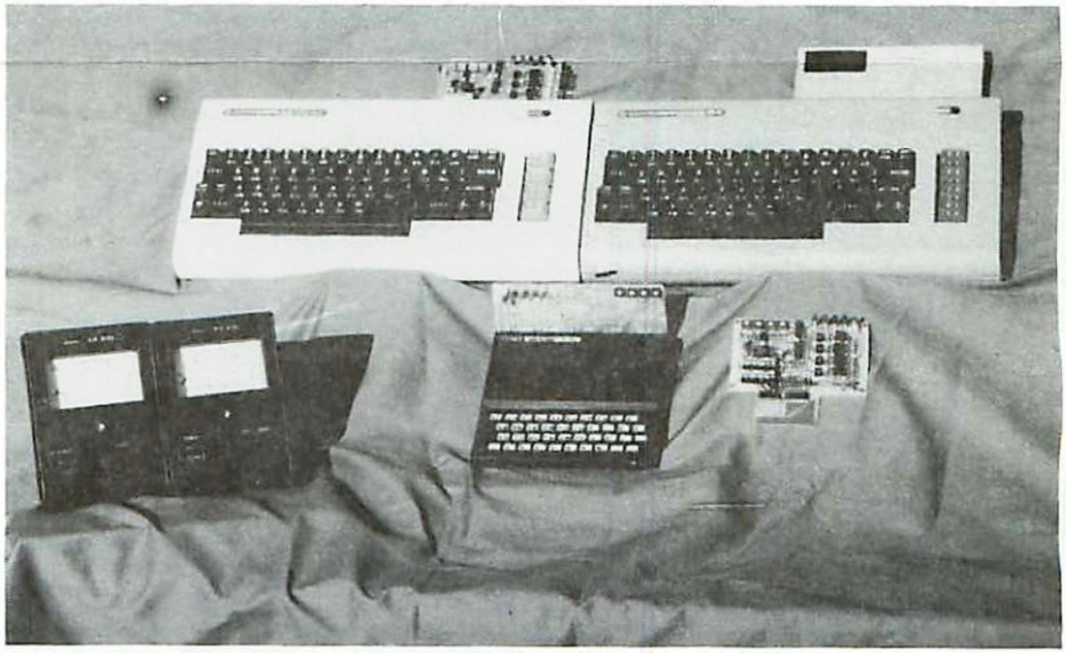
RS-5
Mon Mar 11 01:01:12.644 1985 UTC:
Ascending node at 174.3
Nodal period: 119.55274 min
Longitude increment: 30.015153 deg w/orbit
Element set 220, epoch:
Sat Feb 23 06:26:11.734 1985 UTC

RS-7
Mon Mar 11 01:26:29.438 1985 UTC:
Ascending node at 163.4
Nodal period: 119.19387 min
Longitude increment: 29.925396 deg w/orbit
Element set 192, epoch:
Mon Feb 25 05:41:07.95 1985 UTC

RS-8
Mon Mar 11 00:41:45.228 1985 UTC:
Ascending node at -178.3
Nodal period: 119.76161 min
Longitude increment: 30.067427 deg w/orbit
Element set 310, epoch:
Sat Feb 2 10:26:38.884 1985 UTC

Satellite:	***OSCAR-10***
Catalog number:	14129
Epoch time:	85055.81351891
	Sun Feb 24 19:31:28.33 1985 UTC
Element set:	162
Inclination:	26.0672 deg
RA of node:	151.3504 deg
Eccentricity:	0.5990479
Arg of perigee:	351.0336 deg
Mean anomaly:	1.8484 deg
Mean motion:	2.05855313 rev/day
Decay rate:	-2.9e-07 rev/day²
Epoch rev:	1281
Semi major axis:	26105.553 km
Anom period:	699.520444 min
Apogee:	35365.985 km
Perigee:	4089.032 km
Ref perigee:	2611.81102471
	Sun Feb 24 19:27:52.534 1985 UTC
Beacon:	145.8100 MHz

Satellite:	***OSCAR-11***
Catalog number:	14781
Epoch time:	85051.22662318
	Wed Feb 20 05:26:20.242 1985 UTC
Element set:	57
Inclination:	98.2082 deg
RA of node:	118.2460 deg
Eccentricity:	0.0012191
Arg of perigee:	229.5884 deg
Mean anomaly:	130.4257 deg
Mean motion:	14.61945915 rev/day
Decay rate:	-2.5e-07 rev/day²
Epoch rev:	5194
Semi major axis:	7062.113 km
Anom period:	98.498856 min
Apogee:	704.723 km
Perigee:	687.504 km
Ref perigee:	2607.20184158
	Wed Feb 20 04:50:39.112 1985 UTC
Beacon:	145.8260 MHz



Jim Smith, KA7APJ, AMSAT Area Coordinator for Washington State and Alaska, and proprietor of Spectrum West, donated a Control Autotrak Interface Board to the AMSAT Member Recruitment Drive. Shown here are a VIC-20, a C-64, a T/S 1000, Kenpro rotors and the bare board.

Satellite:	RS-5
Catalog number:	12999
Epoch time:	85054.26819137
Sat Feb 23 06:26:11.734 1985 UTC	
Element set:	220
Inclination:	82.9602 deg
RA of node:	6.8376 deg
Eccentricity:	0.0009750
Arg of perigee:	311.2350 deg
Mean anomaly:	48.7873 deg
Mean motion:	12.05058932 rev/day
Decay rate:	4e-08 rev/day²
Epoch rev:	14018
Semi major axis:	8033.815 km
Anom period:	119.496231 min
Apogee:	1675.415 km
Perigee:	1659.749 km
Ref perigee:	2610.25694542
Sat Feb 23 06:10:00.84 1985 UTC	

Satellite:	RS-8
Catalog number:	12998
Epoch time:	85033.43517227
Sat Feb 2 10:26:38.884 1985 UTC	
Element set:	310
Inclination:	82.9573 deg
RA of node:	20.5848 deg
Eccentricity:	0.0020315
Arg of perigee:	43.9804 deg
Mean anomaly:	316.2868 deg
Mean motion:	12.02953923 rev/day
Decay rate:	4e-08 rev/day²
Epoch rev:	13743
Semi major axis:	8043.191 km
Anom period:	119.705333 min
Apogee:	1691.543 km
Perigee:	1658.863 km
Ref perigee:	2589.44526622
Sat Feb 2 10:41:11.1 1985 UTC	

Satellite:	RS-7
Catalog number:	13001
Epoch time:	85056.23688768
Mon Feb 25 05:41:07.95 1985 UTC	
Element set:	192
Inclination:	82.9565 deg
RA of node:	1.2332 deg
Eccentricity:	0.0020829
Arg of perigee:	228.1513 deg
Mean anomaly:	131.7764 deg
Mean motion:	12.08691800 rev/day
Decay rate:	4e-08 rev/day²
Epoch rev:	14084
Semi major axis:	8017.699 km
Anom period:	119.137070 min
Apogee:	1667.942 km
Perigee:	1634.542 km
Ref perigee:	2612.20660324
Mon Feb 25 04:57:30.519 1985 UTC	

Satellite:	OSCAR-9
Catalog number:	12888
Epoch time:	85052.15431026
Thu Feb 21 03:42:12.406 1985 UTC	
Element set:	734
Inclination:	97.6206 deg
RA of node:	37.2521 deg
Eccentricity:	0.0002079
Arg of perigee:	355.7450 deg
Mean anomaly:	4.3844 deg
Mean motion:	15.26989174 rev/day
Decay rate:	1.47e-05 rev/day²
Epoch rev:	18752
Semi major axis:	6859.921 km
Anom period:	94.303223 min
Apogee:	483.318 km
Perigee:	480.465 km
Ref perigee:	2608.15351268
Thu Feb 21 03:41:03.495 1985 UTC	
Beacon:	145.8250 MHz

Roger Johnson, WBØGAI, partially hidden by the video camera.

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